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ABSTRACT

This report presents a brief enrollment history of Howard Community College (HCC) for 1975 to 1991 and provides enrollment projections through 1993. In addition, the report discusses the use of the age cohort model to project credit enrollments, the change ratio model to project credit and credit-free enrollments, and the use of multivariate regression to model credit enrollments over time. Finally, the report reviews the implications of the projections for enrollment management issues, including a new funding formula, facilities shortages, and current faculty and staff resources. Report highlights include the following: (1) HCC's total full-time equivalent (FTE) enrollment grew from 1,096 in fiscal year (FY) 1975 to 3,300 in FY1991, for an average annual growth rate of 7.2%; (2) total FTE percentage growth was positive in almost every year, though it fell by 1.2% between FY1984 and FY1985; (3) enrollment growth in credit and credit-free programs for FY1992 and FY1993 are expected to be similar to enrollment growth for FY1990 and FY1991; (4) mid-year adjustments indicate that credit enrollment will increase by 10% from FY1991 to FY1992, bringing the college's total credit enrollment to 2,485 FTE, and by another 7% in FY1993, for a total of 2,659 FTE; (5) total FTE enrollment will increase by 7% in FY1992 for a total of 3,535 FTE; and by 5% in FY1993 for a total of 3,709 FTE; (6) past inadequacies in resources may have reduced enrollment growth in credit courses by as much as 50 FTE in fall 1992; and (10) projected growth levels assume relatively stable economic conditions through the end of calendar year 1993. (PAA)

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ENROLLMENT PROJECTIONS AND MANAGEMENT

FY 1993

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RESEARCH REPORT NUMBER 74
OFFICE OF PLANNING AND EVALUATION
HOWARD COMMUNITY COLLEGE

January 24, 1992

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INTRODUCTION

The purpose of this report is twofold. First, it is designed to provide enrollment projections for Fiscal Year 1993 for Howard Community College. Specifically, the report provides estimates for full-time equivalent (FTE) student enrollment in credit and non-credit programs for the coming fiscal year. Final enrollment estimates are based on projections employing different forecasting models as well as additional information not incorporated directly in the models.

The second purpose of the report is to consider issues of enrollment management in concert with enrollment projections. Howard Community College has already moved beyond the point where enrollment projections can be considered solely as a revenue maximization calculation in the budget formulation process. In light of the current budget crisis, a new state funding formula, and constraints on personnel and facilities, the college needs to consider potential enrollment levels as one component in an overall enrollment management process.

The report begins with an executive summary which highlights the findings of the report. Next, the report takes a brief look at the enrollment history of Howard Community College. This is followed by an analysis of enrollment projections and the models which support them. Finally, a discussion of enrollment management is presented to provide a context for the preceding discussion.

EXECUTIVE SUMMARY

The following are the major findings of the report. A more complete discussion of these findings can be found in the body of the report.

- Enrollment growth in credit and credit-free programs for FY92 and FY93 will be similar to enrollment growth between FY90 and FY91.
- Midyear adjustments show credit enrollment will increase by 10 percent in FY92 over FY91, for a total of 2,485 FTE.
- Credit enrollment will increase by 7 percent in FY93 over FY92, for a total of 2,659 FTE.
- Credit-free enrollment will remain relatively constant in FY92 compared to FY91.

- Credit-free enrollment will remain relatively constant in FY93 compared to FY92.

- Total FTE enrollment will therefore increase by 7 percent in FY92 compared to FY91, for a total of 3,535 FTE.

- Total FTE enrollment will therefore increase by 5 percent in FY93 compared to FY92, for a total of 3,709 FTE.

- The above growth levels are "potential" growth levels and assume adequate facilities and personnel resources.

- Past inadequacies in resources may have already dampened enrollment growth in credit courses by as much as 50 FTE in the fall 1992 semester.

- Growth levels assume that current economic conditions will remain relatively constant through the end of the calendar year 1993. If economic conditions improve and unemployment rates drop, enrollment in credit courses will drop and enrollment in credit-free courses will rise.

- Enrollment management decisions must be made in light of the college's strategic priorities as well as resource considerations.

ENROLLMENT HISTORY

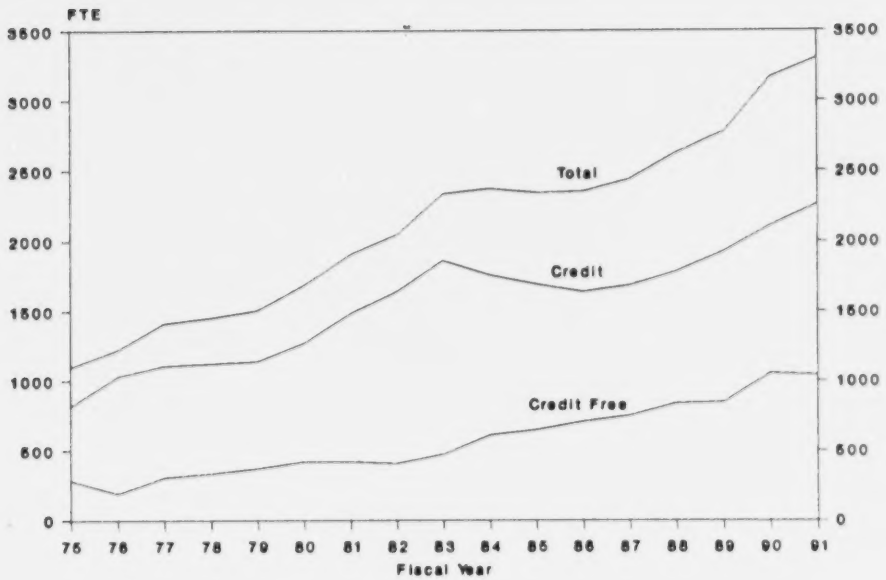
Before examining enrollment projections, it is interesting to first consider the enrollment history of Howard Community College. Understanding past enrollment patterns should provide insights into the factors which influence enrollment growth and decline. Figure 1 shows the college enrollment for the period FY75 to FY91, for credit, credit-free and total full-time equivalent (FTE) students.

As can be seen from this figure, FTE enrollment at HCC has grown considerably over the past sixteen years, from a total FTE of 1,096 in FY75 to 3,300 in FY91. This computes to a growth rate of just over 200 percent for the period and an annual average growth of 7.2 percent. Credit FTE enrollment increased from 816 to 2,258, a growth rate of 177 percent for the period and an average annual growth rate of 6.9 percent. Credit-free FTE increased from 282 to 1,042, a growth rate of 270 percent for the period and an annual average growth rate of 10.1 percent.

Total FTE growth has been positive in every year except from FY84 to FY85 when it fell by 1.2 percent. Although there was an increase in credit FTE enrollment for every year from

FY75 to FY83, this period also had durations of small and large growth. FY77 to FY79 was a time of relatively low or nearly flat growth, at just over 1 percent per year. FY79 to FY83 was a period of high growth, from 10 to 17 percent per year. However, in FY84 and

Figure I. Full-Time Equivalent Student Enrollment - FY75 to FY91



for the next three years, credit enrollments dropped a total of 12 percent. In FY87, enrollments increased again slightly and have been increasing ever since. Over the past four years growth has ranged from 6 to 10 percent. FY92 also shows signs of growth in this range.

Credit-free FTE enrollment has increased in every year but two since FY76. From FY81 to FY82 enrollment declined 3.6 percent and from FY90 to FY91 by 1 percent. In all other years enrollment increases ranged from 1 to 30 percent. The overall pattern is one of steady growth with some large increases over the past 16 years.

The patterns of change noted in the history of enrollment at HCC serve as a starting point for understanding the factors that drive those changes. The task now becomes the identification of the models which correctly explicate those factors and allow enrollment patterns to be explained. If this cannot be achieved, then at least a means of forecasting future enrollment patterns without explanation must be developed. Both types of forecasting models follow in the next section.

ENROLLMENT PROJECTION MODELS

There are numerous explanatory models and an even larger number of sophisticated modeling techniques which have been used to forecast college enrollments. This report uses models based on a combination of three criteria - plausibility, simplicity and availability of data.

Three models are presented for the projection of credit FTE and two models are presented for the projection of credit-free FTE. The three models for credit FTE enrollment projections are the population cohort model, the change ratio model, and a regression model which employs components of the two previous models. The two models used to project credit-free FTE enrollments are the change ratio and regression models.

AGE COHORT MODEL: CREDIT ENROLLMENT

The credit enrollment model which uses age cohorts to determine enrollment projections will be explored first. This model looks at the FTE "going rate" for different age groups (age cohorts) in the population. The model assumes that the FTE's produced by an age cohort in the population can be used as a base to project future FTE enrollment in that cohort in conjunction with the projected population of the cohort.

The tables which follow are designed to take the reader step by step through the calculations of projected FTE based on the model. Table I, *Howard County Population Cohorts*, shows population cohorts for the county from 1982 to 1992 from the Maryland State Department of Planning, revised in September 1989. The cohorts are at five year intervals between the ages of 20 and 59. Given the small number of students aged 0 to 16, they are grouped into one cohort. The same is true for the cohort of all those students 60 and older. Two final cohorts are more limited and they are based on data from the Howard County School System and the Maryland State Department of Education. The first is limited to those either 17 or 18 years old. This cohort represents high school graduates, and the population is the number of high school seniors enrolled in Howard County High Schools the previous year. This is a close approximation to the number of graduates in the year under investigation. The second cohort is limited to those who are 19 years old, and is the number of high school seniors enrolled in Howard County High Schools two years previously. These two cohorts are designed to ascertain the number of students who come to HCC directly from high school and those who may have waited a year before going to college. These traditional groups are broken out to more closely monitor any trends that might occur.

Table II, *Total Credit Hours: Fall Semester by Age Cohort*, shows credit hours for all credit courses for each age cohort. The table covers ten fall semesters, from 1982 to 1991. A quick glance at the table shows that different age cohorts produce greatly different numbers of credit hours and that the numbers tend to decline as the cohorts become older. As can be

Table I: Howard County Population Cohorts
Historical and Projected 1982 to 1992

Age	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
0–16	36,142	36,259	36,572	36,750	38,313	39,340	40,971	43,139	45,817	47,933	49,746
17–18	2,085	1,929	1,918	1,921	2,138	1,984	2,146	2,137	2,034	1,887	2,007
19	1,969	2,085	1,929	1,918	1,921	2,138	1,984	2,146	2,137	2,034	1,887
20–24	10,187	10,904	12,215	13,726	13,940	14,070	14,265	14,542	14,844	14,156	13,567
25–29	11,046	11,196	11,452	11,721	13,235	14,184	15,650	17,812	20,284	19,469	18,782
30–34	13,575	13,740	14,028	14,337	14,852	15,163	15,622	16,265	16,961	18,389	19,779
35–39	12,818	13,360	14,322	15,383	15,908	16,215	16,658	17,257	17,878	18,029	18,173
40–44	9,633	10,128	11,012	11,999	12,926	13,482	14,307	15,454	16,687	17,084	17,447
45–49	7,305	7,562	8,015	8,511	9,272	9,733	10,419	11,388	12,437	13,396	14,318
50–54	6,188	6,339	6,602	6,887	7,335	7,604	8,005	8,567	9,173	9,927	10,655
55–59	4,989	5,129	5,373	5,636	5,863	5,998	6,194	6,461	6,740	7,207	7,660
60+	10,563	11,007	11,789	12,655	13,479	13,966	14,698	15,712	16,803	17,652	18,461
Total	126,500	129,638	135,227	141,444	149,182	153,877	160,919	170,891	181,806	187,158	192,450

Table II: Total Credit Hours: Fall Semester By Age Cohort

Age	Fall Semester												
Cohort	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Avg	Min	Max
0–16	91	72	91	126	92	26	41	51	71	77	74	26	126
17–18	4,107	3,917	3,696	3,291	3,284	3,900	3,793	4,474	3,947	3,769	3,818	3,284	4,474
19	3,850	4,135	3,040	3,332	3,493	3,283	3,938	4,654	4,766	4,526	3,902	3,040	4,766
20–24	6,556	7,023	7,542	7,130	6,715	7,437	8,278	8,749	10,409	11,800	8,164	6,556	11,800
25–29	3,074	3,243	3,061	3,054	3,346	3,226	3,512	3,535	4,492	5,070	3,561	3,054	5,070
30–34	2,091	2,179	2,116	1,885	2,030	2,328	2,347	2,467	2,629	3,100	2,317	1,885	3,100
35–39	2,082	1,719	1,585	1,561	1,606	1,654	1,528	1,820	1,875	2,030	1,746	1,528	2,082
40–44	1,350	1,347	1,159	1,249	1,286	1,315	1,299	1,367	1,279	1,614	1,326	1,159	1,614
45–49	704	691	653	688	704	707	797	714	637	999	729	637	999
50–54	342	218	293	333	325	413	400	326	292	393	334	218	413
55–59	159	114	127	103	72	122	132	223	191	234	148	72	234
60+	335	328	258	247	341	464	435	397	450	536	379	247	536
Total	24,739	24,986	23,621	22,999	23,294	24,875	26,500	28,777	31,038	34,148	26,498	22,999	34,148

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Table III: Credit Hours Per Capita

Age Cohort	Fall Semester												
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	Avg	Min	Max
0–16	0.0025	0.0020	0.0025	0.0034	0.0024	0.0007	0.0010	0.0012	0.0015	0.0016	0.0019	0.0007	0.0034
17–18	1.9695	2.0306	1.9270	1.7132	1.5360	1.9657	1.7675	2.0936	1.9405	1.9974	1.8941	1.5360	2.0936
19	1.9551	1.9832	1.5759	1.7372	1.8183	1.5355	1.9849	2.1687	2.2302	2.2252	1.9214	1.5355	2.2302
20–24	0.6436	0.6441	0.6174	0.5195	0.4817	0.5286	0.5803	0.6016	0.7012	0.8336	0.6152	0.4817	0.8336
25–29	0.2782	0.2897	0.2673	0.2606	0.2528	0.2274	0.2244	0.1985	0.2215	0.2604	0.2481	0.1985	0.2897
30–34	0.1540	0.1586	0.1508	0.1315	0.1367	0.1535	0.1502	0.1517	0.1550	0.1686	0.1511	0.1315	0.1686
35–39	0.1624	0.1287	0.1107	0.1015	0.1010	0.1020	0.0917	0.1055	0.1049	0.1126	0.1121	0.0917	0.1624
40–44	0.1401	0.1330	0.1052	0.1041	0.0995	0.0975	0.0908	0.0885	0.0766	0.0945	0.1030	0.0766	0.1401
45–49	0.0963	0.0914	0.0815	0.0808	0.0759	0.0726	0.0765	0.0627	0.0512	0.0746	0.0764	0.0512	0.0963
50–54	0.0553	0.0344	0.0444	0.0484	0.0443	0.0543	0.0500	0.0381	0.0318	0.0396	0.0440	0.0318	0.0553
55–59	0.0319	0.0222	0.0236	0.0183	0.0123	0.0203	0.0213	0.0345	0.0283	0.0325	0.0245	0.0123	0.0345
60+	0.0318	0.0298	0.0219	0.0195	0.0253	0.0332	0.0296	0.0253	0.0268	0.0304	0.0273	0.0195	0.0332

Table IV: Projected Fall Enrollment 1992

Cohort Population		Credit Hours Per Capita				Total FTE			
Age	1992	Recent	Avg	Min	Max	Recent	Avg	Min	Max
0–16	49,746	0.0016	0.0019	0.0007	0.0034	2.66	3.12	1.10	5.69
17–18	2,007	1.9974	1.8941	1.5360	2.0936	133.62	126.72	102.76	140.06
19	1,887	2.2252	1.9214	1.5355	2.2302	139.96	120.86	96.59	140.28
20–24	13,567	0.8336	0.6152	0.4817	0.8336	376.97	278.19	217.84	376.97
25–29	18,782	0.2604	0.2481	0.1985	0.2897	163.04	155.31	124.25	181.34
30–34	19,779	0.1686	0.1511	0.1315	0.1686	111.14	99.60	86.68	111.14
35–39	18,173	0.1126	0.1121	0.0917	0.1624	68.21	67.90	55.57	98.39
40–44	17,447	0.0945	0.1030	0.0766	0.1401	54.94	59.89	44.58	81.47
45–49	14,318	0.0746	0.0764	0.0512	0.0963	35.59	36.44	24.44	45.96
50–54	10,655	0.0396	0.0440	0.0318	0.0553	14.06	15.64	11.31	19.63
55–59	7,660	0.0325	0.0245	0.0123	0.0345	8.29	6.26	3.14	8.81
60+	18,461	0.0304	0.0273	0.0195	0.0332	18.69	16.83	12.01	20.44
Total FTE						1,127.18	986.76	780.26	1,230.20

seen, the first age cohort (0 to 16) produces very few credit hours and is of little importance. The next three cohorts (17 to 18, 19, and 20 to 24) are by far the most important cohorts, producing the bulk of the credit hours, around 60 percent of the total. Each successive age cohort is less important in overall credit hour production. The final cohort, the 60 plus age cohort, accounts for a higher number of credit hours because of the large age span of the cohort. What is also interesting is that the percentages of total FTE for any cohort remain relatively stable over time with some minor variation.

With these figures, past "going rates" for FTE by age cohort can be calculated and future FTE's by age cohort can be projected. The "going rate" for any age cohort is calculated by dividing its credit hours by its population. Table III, *Credit Hours Per Capita*, shows the going rate for each age cohort. For example, in the fall 1991 semester, the going rate for the age cohort 19-24 is .8336. In general, the table shows that the credit hours per capita, the "going rate," decreases as the age of the cohort increases. The table also computes the average, minimum and maximum value for each age cohort over the ten year period. These computed "going rates" can then be used for enrollment projections.

Table IV, *Projected Fall Enrollment 1992*, provides a series of four estimates of the credit FTE enrollment for the fall 1992 semester. The table shows the estimated size of the 1992 population cohorts and four per capita going rates. These include one for the most recent fall semester (Fall 1991), as well as the average, minimum and maximum going rates. These are used to calculate the fall 1992 FTE enrollment projections which are shown next in the table. The projected FTE enrollment for each cohort are calculated by multiplying the projected population for any cohort by the credit hour per capita going rate for that cohort and dividing that number by 30 (one FTE is equal to 30 credit hours). Projections for the fall semester are then obtained by summing all of the individual cohort FTE projections. Projections are provided for each of the four going rate estimators. The most recent estimate (1127.18) projects enrollments if the going rate for fall 1990 is replicated in the following years. The average projection (986.16) uses the average going rates for the last ten years, while the minimum (780.26) and maximum (1230.2) estimates use the largest and smallest rates respectively and provide upper and lower bounds for enrollment estimates.

Each of these going rates is produced to allow for different projections based on qualitative assumptions to be incorporated later. If, for example it is assumed that FTE enrollment for FY92 would follow the same pattern as FY90, then the 'most recent' going rate estimator would be used. The judgement as to which estimator should be used cannot be determined by the model. It must be determined by qualitative factors which have not been incorporated into these estimation techniques.

Fall to Fiscal Year Enrollments

Estimates for fall semesters for credit courses as produced by the age cohort model must be converted into fiscal year estimates. Table V, *Fall and Fiscal Year Enrollment*, shows the fiscal year to fall ratio of FTE enrollments at HCC for eight years. An average, minimum, maximum and most recent ratio are also shown. These ratios can then be used to convert the fall FTE age cohort model estimates into estimates for an entire fiscal year. They can also be used to modify previous estimates for the fiscal year.

Table V: Fall and Fiscal Year Credit FTE Enrollment

Fall	Fall Credit FTE	Fiscal Year	Total Credit FTE	FY/ Fall Ratio
1983	830.97	FY 84	1756.36	2.114
1984	782.63	FY 87	1693.53	2.164
1985	762.17	FY 86	1639.91	2.152
1986	771.17	FY 87	1685.24	2.185
1987	825.17	FY 88	1782.40	2.160
1988	880.30	FY 89	1924.57	2.186
1989	952.03	FY 90	2108.37	2.215
1990	1024.70	FY 91	2257.80	2.203
Fiscal Year to Fall Credit FTE Ratios		Minimum		2.114
		Average		2.172
		Maximum		2.215
		Most Recent		2.203

Table VI, *Projected FY93 Credit Course Enrollment*, shows the projected credit course enrollment for FY93 for all of the possible combinations of the estimates from the age cohort model and the fiscal year to fall enrollment ratios. This produces a total of 16 projected fiscal year enrollment estimates. These estimates set the minimum and maximum bounds for any enrollment projection as well as providing information on the average and most recent results. As can be seen, the range of the estimates is rather broad, from an absolute minimum of 1,649 to an absolute maximum of 2,496, for a difference of 847 FTE. Average and most recent enrollment projections provide estimates within these bounds and can be used to select estimates which fit with underlying assumptions or based on the risks the projector is willing to make. The safest selection, the one with the greatest expected value of occurring is the average projection, which is 2,144. If, on the other hand, the next year seems to be a lot like the last year, then perhaps the most recent projection is the best; in this case the projection is 2,484.

Table VI: Projected FY 1993 Credit Course FTE Enrollment

Fall to Fiscal Year Credit FTE Ratios		Fall 1992 Cohort Enrollment Projections			
		Minimum	Average	Maximum	Most Recent
		780.26	986.76	1230.2	1127.18
Minimum	2.114	1649	2086	2600	2382
Average	2.172	1695	2144	2672	2449
Maximum	2.215	1728	2185	2724	2496
Most Recent	2.203	1719	2174	2711	2484

Two factors about the estimation technique of the age cohort model should be noted in concluding this section. First, the range of estimates produced by this model are extreme when the estimates include the maximum and minimum conditions. While there is not a great amount of variation in going rates for most cohorts over time, this variation, when maximized and minimized for all the cohorts at one time, produces a significant overall variation. Second, the estimates produced by the model are very conservative when only the average or most recent conditions are applied. Since the other variable in the equation is the population of a cohort, and this value tends to change slowly over time, the estimates produced by these conditions are likely to be conservative.

The trick to effectively using the age cohort model as a forecasting tool is in knowing which cohort going rates to use. Unfortunately, the model does not supply information which will enable an analyst to know which variation of the model to employ. This information must be supplied by the analyst making the estimation based on conditions and information outside the model.

Apart from its ability to forecast, the model does supply some valuable information, demonstrating the relationship between age and credit enrollment. Clearly, students aged 17 to 24 provide the vast bulk of the credit FTE enrollment. Older students may account for a large portion of the college's total headcount enrollment, but their going rates are much lower than for the more traditionally aged students.

Change Ratio Model: Credit and Credit Free Enrollment

The change ratio model presented here is a variation of the model used to provide enrollment projections for space requirements in the college's Master Site Plan. The major difference is that the master site plan model attempted to predict enrollment five years into the future while the current models are only designed to predict enrollments one year into the future.

Table VII: FTE Enrollment 1975 to 1990: Credit, Credit–Free, and Total

	1975	1976	1977	1978	1979	1980	1981	1982	1983
Credit	816	1,029	1,106	1,121	1,139	1,269	1,487	1,639	1,861
Credit Free	282	190	306	331	368	416	419	404	471
Total	1,098	1,219	1,412	1,452	1,507	1,685	1,906	2,043	2,332

	1984	1985	1986	1987	1988	1989	1990	1991
Credit	1,757	1,693	1,640	1,686	1,783	1,925	2,109	2,258
Credit Free	611	647	709	749	838	847	1,053	1,042
Total	2,368	2,340	2,349	2,435	2,621	2,772	3,162	3,300

Table VIII: One Year Change Ratios of FTE Enrollment

	75/76	76/77	77/78	78/79	79/80	80/81	81/82	82/83
Credit	1.261	1.075	1.014	1.016	1.114	1.172	1.102	1.135
Credit Free	0.674	1.611	1.082	1.112	1.130	1.007	0.964	1.166
Total	1.110	1.158	1.028	1.038	1.118	1.131	1.072	1.141

	83/84	84/85	85/86	86/87	87/88	88/89	89/90	90/91
Credit	0.944	0.964	0.969	1.028	1.058	1.080	1.096	1.071
Credit Free	1.297	1.059	1.096	1.056	1.119	1.011	1.243	0.990
Total	1.015	0.988	1.004	1.037	1.076	1.058	1.141	1.044

Table IX: Three Year Change Ratios of FTE Enrollment

	76–78	77–79	78–80	79–81	80–82	81–83	82–84
Credit	1.116	1.035	1.048	1.101	1.129	1.136	1.061
Credit Free	1.122	1.268	1.108	1.083	1.034	1.046	1.142
Total	1.099	1.075	1.061	1.096	1.107	1.115	1.076

	83–85	84–86	85–87	86–88	87–89	88–90	89–91
Credit	1.014	0.959	0.987	1.018	1.055	1.078	1.082
Credit Free	1.174	1.151	1.070	1.090	1.062	1.124	1.081
Total	1.048	1.002	1.010	1.039	1.057	1.092	1.081

Table X: Five Year Change Ratios of FTE Enrollment

	76–80	77–81	78–82	79–83	80–84	81–85	82–86	83–87
Credit	1.096	1.078	1.084	1.108	1.094	1.063	1.023	1.008
Credit Free	1.122	1.188	1.059	1.076	1.113	1.099	1.116	1.135
Total	1.091	1.095	1.077	1.100	1.096	1.070	1.044	1.037

	84–88	85–89	86–90	87–91
Credit	0.992	1.019	1.046	1.066
Credit Free	1.125	1.068	1.105	1.084
Total	1.024	1.033	1.063	1.071

Table XI: Ten Year Change Ratios of FTE Enrollment

	76–85	77–86	78–87	79–88	80–89	81–90	82–91
Credit	1.080	1.050	1.046	1.050	1.057	1.055	1.045
Credit Free	1.110	1.152	1.097	1.101	1.091	1.102	1.100
Total	1.080	1.069	1.057	1.062	1.064	1.066	1.058

This model, unlike the age cohort model does not seek to explain enrollment patterns, rather it is designed to serve solely as a projection tool.

The change ratio model is used here to project FTE enrollments for both credit and credit-free courses. The algorithm which underlies both projection models is the same. The model is a relatively straightforward averaging model which uses different time periods to make linear estimates of enrollment growth. The model uses FTE enrollment histories and projects a pattern of growth similar to the past.

Four different models are used to determine four different sets of change ratios. The first model uses changes over a single year period. The second, third and fourth models use three, five and ten year periods averaging the change ratios over those periods. For each period a ratio is produced which measures the average change between the first and last year in the period. This change ratio is then used to project enrollments for the first year following the period.

Table VII, *FTE Enrollment 1975 to 1990*, presents FTE enrollment information from FY75 to FY91. Tables VIII, IX, X, and XI present the change ratios calculated from the data in Table VI for the one, three, five and ten year change ratios respectively. Some examples of these calculations follow. In FY90, the total FTE enrollment was 3,162 and in FY91 it was 3,300. The change ratio for this period is 1.044 as shown in Table VIII. In FY89 total FTE enrollment was 2,772 and in FY91 it was 3,300. The change ratio for this three year period is 1.081 as shown in Table IX.

Since these four models have no theoretical underpinnings, their utility is determined by their predictive power. This is accomplished by comparing their enrollment forecasts to the actual enrollments for past years. These comparisons can be found in Tables XII through XV. That is, in trying to use past patterns to predict future actions we can compare the predictive power of models to actual enrollments in these tables. This should provide us with information concerning the most accurate models in predicting out year performance. For example, Table XII compares enrollment predictions of our one year change model to actual enrollments the next year. Consider credit course enrollments only. In FY88, the model prediction was 2.79 percentage points below actual enrollment; in FY89 it was 2.05 percentage points low; in FY90 it was 1.46 percentage points low; and in FY 1991, it was 2.33 percentage points high. Over the past four years the model was within three percentage points of predicting enrollments one year out, a highly accurate predictor.

Unfortunately, when information on the prediction accuracy for all the change ratio models is reviewed, it is clear that the change ratio model fails as a highly accurate forecaster of enrollments. Predictions for credit-free enrollment for all the change ratio periods are subject to wide swings. Credit enrollment change ratio predictors fare better; however, they also have problems. Those change ratios for one year and ten year periods have shown the most accuracy in predicting next years' enrollments with those for one year being slightly better. Predictions for three and five years change ratios are less accurate. While this model

Table XII: Percent Difference: Projected Minus Actual
One Year Change Ratios

	1977	1978	1979	1980	1981	1982	1983	1984
Credit	17.32	6.04	−0.25	−8.80	−4.92	6.31	−2.93	20.27
Credit Free	−58.17	48.89	−2.71	−1.65	12.23	4.46	−17.30	−10.13
Total	−4.15	12.64	−0.92	−7.18	−1.15	5.53	−6.10	12.41

	1985	1986	1987	1988	1989	1990	1991
Credit	−2.02	−0.53	−5.77	−2.79	−2.05	−1.46	2.33
Credit Free	22.51	−3.37	3.73	−5.58	10.69	−18.70	25.63
Total	2.76	−1.56	−3.16	−3.70	1.78	−7.28	9.30

Table XIII: Percent Difference: Projected Minus Actual
Three Year Change Ratios

	1979	1980	1981	1982	1983	1984	1985
Credit	9.88	−7.12	−10.57	−0.14	−0.53	20.38	10.07
Credit Free	0.92	12.17	10.00	12.34	−11.31	−19.39	7.89
Total	5.88	−3.87	−6.16	2.22	−3.01	9.79	8.91

	1986	1987	1988	1989	1990	1991
Credit	4.72	−6.74	−6.69	−5.70	−3.70	0.65
Credit Free	7.13	8.92	−4.33	7.88	−14.58	13.61
Total	4.43	−3.29	−6.21	−1.76	−7.35	4.59

Table XIV: Percent Difference: Projected Minus Actual
Five Year Change Ratios

	1981	1982	1983	1984	1985	1986
Credit	−6.5	−2.2	−4.6	17.4	13.5	9.8
Credit Free	11.4	23.2	−9.2	−17.1	5.1	0.3
Total	−3.6	2.1	−5.6	8.3	10.9	6.6

	1987	1988	1989	1990	1991
Credit	−0.5	−4.7	−8.1	−6.9	−2.3
Credit Free	5.7	1.4	11.3	−14.1	11.7
Total	0.7	−3.6	−3.2	−9.5	1.9

Table XV: Percent Difference: Projected Minus Actual
Ten Year Change Ratios

	1986	1987	1988	1989	1990	1991
Credit	11.5	2.2	−1.1	−2.7	−3.6	−1.5
Credit Free	1.3	9.1	−2.0	8.9	−12.3	11.3
Total	7.6	3.2	−1.8	0.4	−6.7	2.2

has some limited utility in predicting credit FTE enrollments, it also has a large error margin. Even the best change ratio predictor, that of a one year period for credit enrollments, missed by 20 percent in FY84. For credit-free enrollments the error margin has been subject to very wide swings, underestimating by 18.7 percent in FY90, and overestimating by 25 percent in FY91.

While patterns of past behavior in some arenas are useful predictors, this is clearly not the case with the change ratio models. However, while the model may not always provide us with accurate forecasts, it does reveal that the best estimate of change next year is what happened in the previous year. The important point then becomes knowing when the pattern will continue and when it will change. The conditions which will lead to stability or change are the focus of the third model.

Regression Model

The final enrollment projections model is a multivariate regression model, which builds on both of the previous models as well as incorporating new information. First, it employs the first enrollment model's use of age cohorts and population size. Second, the model employs the change ratio model concept of averaging changes over time. Additionally, the model introduces new variables related to enrollment into the equation. While a few variables were tested, such as economic conditions, costs of education and structural reforms, only the economic variable was found to be significant and is included here.

Two regression models are set forth in this section, one for credit enrollment and one for credit-free enrollment. Both regression models argue that enrollment levels can be based on two factors - potential student population and labor force conditions. These two concepts can be more specifically operationalized as service area or county population and levels of county unemployment.

The regression model for credit course FTE enrollments utilizes three variables to model credit enrollments over time. The first two variables are based on population and are related to the age cohort model. Since younger more traditional students comprise a distinct group of students with very high going rates, they are included as one of the variables. The other population variable is the remainder of the school age population. The third variable is the unemployment rate in the county. It has long been maintained that unemployment levels and educational enrollment are related; that is, when unemployment rises the level of enrollment will also rise.

For the credit-free regression model two variables are employed, one for population and one for unemployment. While the relationship between population and enrollment is the same as for credit enrollment and is quite clear, the relationship between unemployment and credit-free enrollment is not so clear. Since a good deal of credit free enrollment may result from either business enrollment or recreational enrollment, it is quite possible that enrollments will decline during hard economic times.

Table XVI: Enrollment Regression Model

A. Credit Model

Dependent Variable: Credit FTE Enrollment			
Variables	B	T	Significance
Constant	−1776.86	−2.369	0.0497
Pop1719	0.57241	2.504	0.0408
Pop20plus	0.009836	3.455	0.0106
Unemployment	88.15231	3.180	0.0155
R−Square	.91		

B. Credit−free Model

Dependent Variable: Credit−Free FTE Enrollment			
Variables	B	T	Significance
Constant	−378.11	−2.937	0.0188
Pop16plus	0.01123	12.369	0.0000
Unemployment	−31.1451	−2.412	0.0424
R−Square	.98		

Table XVI, *Enrollment Regression Models*, shows the results for the regression model for credit and credit-free enrollment. For both models the findings are highly significant. For the credit model, all the variables and the constant are statistically significant and the R-square for the model is .91. The t values and the significance level show that all the variables are statistically significant at the .05 level. The R-square statistic is the percent of the total variance in the model which is explained by the dependent variables. For the credit-free model all the variables and the constant are statistically significant and the R-square for the model is .98.

These models clearly relate two key factors to enrollment growth, potential student market and economic conditions. For the credit model, all the variables are positively related. That is, as they increase enrollment increases. Just as the age cohort model shows, the younger traditional population cohorts are the most important. The B coefficients show the relative importance of each variable. Every member of the cohort aged 17 to 19 (POP1719) accounts for .57 FTE. For the rest of the population, those 20 and older (POP20PLUS), the factor drops to .09 FTE. Unemployment is also positively related. For each point of unemployment, the FTE enrollment increases 88.1 FTE. These findings confirm our previous thoughts about the variables that are related to enrollment.

For credit-free enrollment, the population variable is significant. For every member of the population 16 and older (POP16PLUS), the FTE rate increases by .011. However, unemployment is negatively related to FTE growth for credit-free courses. For every point the unemployment rate increases, enrollment drops by 31.1 FTE. While the conventional wisdom holds that unemployment is positively related to FTE growth, this is probably restricted to the credit area. Credit-free enrollment depends both on business training and recreational courses for a portion of its overall enrollment. Both of these areas are likely to suffer in a time of economic downturn and high unemployment as businesses cut back training expenses and people limit recreational expenses.

The results of this section confirm the positive relationship between the potential market (population), and enrollment growth. However, what is perhaps most interesting is that credit enrollments and credit-free enrollments respond differently to unfavorable economic conditions. Knowing the conditions which lead to enrollment changes as outlined in this model, it may now be possible to identify conditions which will lead to stability or change in enrollment in the next fiscal year.

MIDYEAR ADJUSTMENTS

The previous discussion should make it clear that all enrollment forecasts are subject to a considerable degree of error in the short term. Since the projections models are based on previous behaviors continuing, the errors are especially great when conditions unexpectedly change. Given these problems, a method for midyear reassessment of FTE enrollments to enable the college to make budgetary adjustments is important. For credit FTE enrollments, there is a method within a fiscal year to make mid-year adjustments. This adjustment is based on the ratio of fiscal year to fall semester credit FTE enrollments.

FTE enrollments for the fall semester are finalized at the end of the third week of classes and the data is available by mid October. This data can then be used to make overall adjustments. As shown in Table V, and discussed previously, over the past eight years the fall semesters have accounted for a relatively stable portion of total enrollments. The ratio of fiscal year to fall enrollments has ranged between 2.114 and 2.215. Using ratios over the past three years, which are very stable, provides a good ratio of 2.201, which is nearly equivalent to the most recent ratio in FY91. Fall 1990 enrollment was 1128.03. Using the most recent ratio of 2.203, this computes to a FY92 credit enrollment of 2485.47. This amounts to an increase of 227.67 FTE over the previous year and computes to an annual increase or change ratio of 10.0 percent.

This provides us with a good and accurate measure for adjusting budgetary expectations early into the next fiscal year. However, this method only works for credit FTE enrollment. So far, no means of adjusting credit-free enrollment has been discerned.

FY 1993 Enrollment Projections

Based on the preceding models it is clear that no definitive forecasting model is available. Simply put, there is no formula into which a series of numbers can be entered that will produce a value that accurately predicts enrollments. When forecasting enrollments, the models are more likely to be accurate in the long run than in the short run. That is, over a ten year period the formula may average out and be close to actual enrollments. However, in any single year the forecasts are subject to wide swings and great inaccuracy.

In spite of the lack of short term forecasting accuracy, the findings based on the models are important to our understanding of enrollment projections. That is, we can use the findings from the models and incorporate then into informed judgements about enrollment projections. This approach could be called a quantitatively informed qualitative judgement. It combines information obtained from the above models as well as informed assessment about future conditions into the projections process. The projections for FY93 follow along with the rationale used to support them.

Credit Enrollment Projection

FTE enrollment in credit courses should increase 7 percent in FY93 over FY92.

FTE credit enrollment has the potential to increase at a rate of 10 percent at the maximum; however, it is more likely that the average or expected rate will be somewhere in the neighborhood of 7 percent.

This projection is based on the following points. First, the best predictor of credit enrollment growth is the most recent level of that growth. That is, what happened last fiscal year is most likely to occur next year if relevant conditions remain the same. The increase for FY91 over FY90 was 7 percent and the projected increase in FY92 over FY91 is 10 percent. The conditions which are of concern are economic conditions (unemployment) and potential market (student population, especially those for the most important cohorts). Both of the important conditions show no change in the coming year; however, economic conditions could begin to improve reducing credit enrollment. Population cohorts will continue to grow slightly overall, while the most important cohort, that aged 17 to 19, will increase next year by just over 6 percent. Economic conditions are projected to improve sometime over the next year, but unemployment usually lags in times of economic recovery and should not improve until the end of 1993. Therefore, the potential for growth in credit courses in FY93 could be similar to last year's, a maximum of 10 percent, but it is more likely that the range will be around 7 percent.

Credit-Free Enrollment Projection

FTE enrollment for credit-free courses should remain relatively constant in FY93, if the economic conditions remain unchanged. If the economy begins to improve, then credit-free FTE might also improve.

The models tested above demonstrate the difficulty in predicting credit-free enrollments. However, as with the credit enrollment models, two variables, population and unemployment, are again important. While the overall population will continue to grow, if unemployment remains the same the probability is that credit-free enrollments will remain relatively constant. Unemployment is negatively related to credit-free enrollment according to the findings from the models. While there is no good predictor model, it seems reasonable to assume that most recent behaviors are the best predictors assuming other things remain equal. Given last year's performance in credit-free enrollment and the economic conditions outlined, the outlook for credit-free enrollment is one of no growth.

Other Considerations on Enrollment Projections

Before closing the discussion on FY93 enrollment projections, one caveat is in order. The above projections are best described as enrollment growth potentials. They are contingent on all conditions remaining the same. An increased emphasis in recruitment or marketing can alter conditions and further increase enrollments. Likewise, a diminution of marketing efforts or changes in other factors can also decrease enrollments.

A second consideration is also of concern. While actual enrollment growth and enrollment potential in credit courses has been strong over the past few years, it is not likely to continue in the long run. If economic conditions improve and the level of unemployment falls significantly in the next two or three years, it is likely that college credit enrollment will also decline. In the mid 1980's, the college saw a similar phenomenon when its enrollments increased dramatically during hard economic times only to decrease later. This scenario is likely to repeat itself either in FY94 or FY95. However, the degree or exact period of this decline is hard to project.

Enrollment Management

The preceding section on enrollment projections while important should not be considered in a vacuum. Rather, these projections should be considered in the larger context of enrollment management. Within the context of enrollment management, enrollment projections constitute the demand factor for education. Items which relate directly to the supply of education must also be considered; including items such as funding formulas, budget

revenues, facilities availability, faculty and staff resources. While a supply and demand analysis can explicate the many important issues, it cannot by itself provide answers to these problems. Final policy decisions must be made in light of the colleges mission and strategic priorities. What follows is a brief discussion of some of the factors related to enrollment management.

Funding Considerations

College revenue projections have always been closely tied to FTE enrollment projections. Enrollment projections are still important when calculating revenues generated by tuition. As credit tuition increases and tuition becomes a more important component of overall budget revenues, the linkage is likely to remain. At the current in-county rate of $56 per credit hour and consolidated fee of 10 percent, total tuition generated per FTE is approximately $1,850.

Enrollment projections are less important today respecting state revenues. In the past, college funding from the state was based almost entirely on FTE enrollment. Simply, the funding formula paid the college a fixed dollar amount for every FTE. In 1988, prior to the reform of state funding law, this amounted to $980 per FTE. The new funding formula established a system for funding colleges which included both a fixed cost grant not related to FTE and a portion of the budget related to FTE. In 1992, the funding formula was again revised and while the basic structure of the 1988 funding system was maintained, fixed and FTE funding, the per FTE contribution dropped again. For FY93, it is estimated that the funding per FTE will be approximately $330. At the same time, the total amount of funding the state provides as a percentage of the college's budget has also declined. In FY80, state aid accounted for 36 percent of the college's revenues. By FY90, this amount had dropped to 26 percent.

If the overall revenue generation per FTE is compared for FY93 and FY88, the result is that the funding generated per FTE for credit enrollment has remained constant at $2,180. For FY93, the total is $330 in state funds plus $1,850 in tuition. In FY88, the total was $980 in state funds and $1,200 in tuition. This is a simple calculation, but it shows that over the past six years the funds generated per FTE have declined by the amount of increase in the cost of living. For credit-free courses and FTE there is no simple calculation.

Facilities Availability

Rapid enrollment growth over the past few years has led to a shortage of classrooms. While utilization analysis has not been undertaken to study the extent of the problem, a qualitative assessment based on the opinions of the registrar and others makes it clear that during peak times classrooms are full or near capacity. While a new classroom building has been proposed, it will not be completed in time to affect classes in FY93 nor perhaps for FY94.

The number of available classroom spaces will probably need to be increased if the college is going to meet significant credit enrollment increases. Additional classroom spaces may be obtained in three ways. First, increase the number of classrooms. This can be done by renting additional space from the county, or increasing the number of classrooms on campus. Second, increase the utilization of current classroom facilities. Classroom schedules could be expanded to times when they are currently not being utilized. Third, increase the number of classroom spaces by increasing the size of classes. The effectiveness of this strategy is obviously limited by the size of the rooms and the ability of the faculty to effectively teach larger classes.

Support facilities such as the library, study areas, and parking will also need to be considered as part of overall enrollment management. Although the immediate consequences of shortages in these areas is not as direct as that of classroom space, in the long run they will affect the student learning environment.

Faculty and Staff Resources

In addition to the burden placed on facilities by increasing enrollments, the college must also consider the impact of increased enrollments on human resources.

Over the past few years the college has made a concerted effort to increase the number of full-time faculty and to increase the percentage of course credit hours and students taught by full-time faculty members. Enrollment growth at rapid levels will require additional faculty be hired to achieve this goal at the expense of other demands in a time of declining resources. That is, to grow will cost more money than it will bring in if the goal is to be accomplished with full-time faculty.

Another way of accommodating enrollment and faculty availability is to increase class sizes. This is again a trade off position, for the college is committed to priorities which include teaching excellence and student learning; and customer service. Each of these goals is likely to suffer if class sizes increase.

While human resources will directly affect faculty other services supplied by college employees will also suffer under the weight of increased enrollment. Demands on student support services and administrative services will also increase and timeliness and quality may suffer as a result.

Strategic Priorities

While the supply factors noted above are extremely important, the final mix of these factors into a coherent enrollment policy must be based on the college's basic mission and strategic priorities which were established to guide the college over the long run. For example, with a limit on resources, the priorities of student access and teaching excellence will need to be balanced. In a time of moderate enrollment and plentiful resources these two priorities can each be pursued without any possible contention. However, if growth continues and resources remain constant or decline, enrollment management may require that the college limits credit enrollment which may directly affect student access. Other hard choices may also arise.

Enrollment Management Approach

The preceding discussion is in no way intended to be a definitive discussion of enrollment management. Rather, it is designed to provide an analysis of some of the factors which should be considered in conjunction with the college's enrollment projections. Final consideration of the factors to be included in the analysis, the relationship between those factors and the strategic priorities must be made by the president and the cabinet.

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